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gray ring of a Masson's disk and the adjacent wholly white one, the sensation comes and goes at somewhat regular intervals. After an experimental study of the phenomenon, N. Lange came to the conclusion that the cause was central and the variation a rhythm of apperception. (*Phil. Studien*, IV, 390 ff.) This view is vigorously attacked by Münsterberg. The experiments upon which he rests his attack were as follows. The subject fixed his eyes and attention on the line of demarkation of a Masson's disk 2 m. distant, and recorded the ebb and flow of sensation by moving with his finger a lever adjusted to write upon a revolving drum, the finger rising as the sensation intensified and falling as it faded, through a period of from 60 to 80 secs. In the first series the average length of time from the beginning of one disappearance to the beginning of the next was 6.9 secs., (Lange, 3.1-3.4) with a mean variation of 1.1 sec. The subject noticed faint sensations of motion in the eyes accompanying the fluctuations. In the next series, prisms were brought before the eyes and removed alternately for periods of two seconds, causing a deviation of the eyes without disturbing the vision of the rings; the result was a lengthening of the period to 12.3 secs. Voluntary closure of the eyes every second or two seconds generally prevented the fluctuations, while the interposition of a gray screen before the disk, though interrupting vision for a slightly longer time, increased their rapidity, making them now recur in 5.8 secs. More rapid interposition and removal of the screen caused a lengthening of the periods; and when the disk was covered continuously for a full second out of every four, the continuity of the sensation was broken up and no fluctuations were found. Observations with indirect vision gave a rate of 8.2 secs. Continuous movements of the whole disk up and down or from side to side at the rate of 10 cm. per second, bringing it to its original position every four seconds, caused total suspension of the periodicity. Very rapid breathing quickened it to 5.1 secs.; slow breathing slowed it to 8.5; but the periodicity did not seem causally dependent on respiration. Several of these tests were also tried with similar results by the observation of a black dot on a large white field. The chief points in the interpretation of these experiments, to which a long section is devoted, are as follows. The whole group shows the phenomenon in question to be of peripheral and not central origin, (else why the profound effects of purely peripheral changes?) and in particular from the fatigue of the muscles of fixation and accommodation. The prisms lengthened the period because the deviation of the eyes which they caused relieved the fatigue of fixation and lessened that of accommodation; the winking experiments relieved the latter and so prevented the failure of accommodation, and thereby the disappearance of the demarkation line on the disk. The interposition of the screen had the contrary effect because it did not relieve accommodation, but rather made it more difficult. In a similar way the other experiments support the muscle-fatigue theory; and what is thus demonstrated for the muscles of the eye, Münsterberg carries over to the less accessible muscles of the ear. The experiments form a valuable contribution to the subject and are demonstrative on the point immediately in question, to wit, the very important function of the periphery in the variations of faint visual sensations. Some portions of his critique upon Lange, however, seem to us less sound, and indeed in explaining Lange's experiment with faint stimuli to two senses at once he introduces central processes (in a secondary position, to be sure) not unworthy the name of changes of attention.

Augenmass. MÜNSTERBERG. *Ibid.*

After the usual historical and critical review the author makes preliminary report on the results of a comprehensive study of the conditions

affecting visual estimation of the separation of points and the length of lines. Besides this immediate object the author explains the aim of his experiments to be the examination of how far eye movements, or rather variations in the intensity of the sensations accompanying them, are responsible for visual judgments, all this forming part of a plan for demonstrating that the comparison of sensations, etc., (generally conceived to be an act of consciousness as opposed to a content of consciousness,) is in reality itself a content and not an act. The 20,000 observations already made by Münsterberg are distributed in groups of from 400 to 800 among 36 variations of condition. The apparatus used was simple and convenient; the method was a modification of that of average error; the 20 standard distances used ranged from 1 to 20 cm., by differences of 1 cm.; the experimenter worked on himself. The variations included the use of empty spaces and horizontal and vertical lines, seen monocularly and binocularly, with and without motion of the eyes, and in the indirect field, with reproduction at different time intervals after seeing the standard, etc., etc. A bare statement of the final figures in these 36 cases would unduly lengthen this notice; some of the more general conclusions are as follows. The experiments show decidedly that changes of motion, position or use of the eyes produce marked changes in the estimate of distances, to be explained only by the participation of sensations of motion or their memory images; these cannot be given a secondary place in any theory of vision. Empty distances on the right were under-estimated, on the left over-estimated, a fact which the author connects with common practices in reading and writing. The eyes when used separately each over-estimated extensions on its own side. Extensions reproduced after an interval were generally over-estimated, especially the smaller ones; the reproduction was much more accurate if the reproduced lengths occupied exactly the same position as the original. Lines did not seem greater than equal empty spaces, a seeming contradiction of the commonly recognized illusion which Münsterberg, however, explains. Broken lines seemed as usual too long. Lines, unlike empty spaces, were reproduced smaller in both halves of the field, because, as it seems, the eye does not traverse the whole of the standard line, judging partly by indirect vision, and does traverse the whole of the line reproduced, thus giving the latter more sensation of muscular effort. Münsterberg finds the commonly accepted over-estimation of vertical distances only on three conditions, namely, when the distances are empty, the vertical is above the horizontal with which it is compared, and the eyes are free to move. Distances above the horizontal seem longer than equal distances below, if both are of considerable length. Turning from the constant to the variable error, the true measure of the differential threshold, the experiments show it much greater when the eyes are fixed, the difference being due to the fact that in the first case the judgment is based on motions actually executed and in the second on the remembrance of such motions. The variable error is increased or diminished by one and another of the conditions examined; but, other things being equal, Weber's Law holds with a reasonable exactness for the distances experimented upon. What it really applies to, however, is not the estimation of visual extensity, but to the changes of intensity in the motor sensations of the eye.

Raumsinn des Ohres. MÜNSTERBERG. Ibid.

The author's theory of the auditory perception of space, arrived at in the original after an examination of previous experiments on sound-localization, and on the functions of the semicircular canals, is briefly this. Sounds differ according to the direction from which they come, independently of changes in quality, intensity, etc., in the disturbance which they produce in the semicircular canals. With these differ-